# Appendix I
# Energy Resources Evaluation

# Contents



## Tables

# Abbreviations and Acronyms

| | |
|---|---|
| Banks Pumping Plant | Harvey O. Banks Pumping Plant |
| CVP | Central Valley Project |
| Delta | Sacramento-San Joaquin River Delta |
| DMC | Delta-Mendota Canal |
| GWH | gigawatt hour(s) |
| Jones Pumping Plant | C.W. “Bill” Jones Pumping Plant |
| MWH | megawatt hour(s) |
| Reclamation | Bureau of Reclamation |
| SWP | State Water Project |
| Western | Western Area Power Administration |

# Appendix I
# Energy Resources Evaluation

## I.1 Existing Conditions

The Delta-Mendota Canal (DMC) Recirculation Project includes the use of C.W. "Bill" Jones Pumping Plant (Jones Pumping Plant) near Tracy, California, which is part of the Central Valley Project (CVP) and is used for the operation of the DMC. Jones Pumping Plant includes six pumps with a total pumping capacity of 4,602 cubic feet per second. Total dynamic head for these pumps is 197 feet with a total horsepower of 135,000 operating at about 75 percent efficiency. Locations of key components of the DMC Recirculation Project are shown on **Figure 2-1** in the Plan Formulation Report.

Operation of CVP and State Water Project (SWP) systems require a large amount of power to pump water from the northern to southern regions of the State. The DMC Recirculation Project would primarily affect pumping loads at Jones Pumping Plant, which pumps water from the Sacramento-San Joaquin River Delta (Delta) through the DMC as part of the CVP. Its counterpart on the SWP system is Harvey O. Banks Pumping Plant (Banks Pumping Plant), which pumps water from the Delta through the California Aqueduct. Four of the six DMC Recirculation alternative plans use both Banks and Jones pumping plants. According to State Water Resource Control Board's Water Rights Decision 1641, these two plants are operated jointly by California Department of Water Resources and Bureau of Reclamation (Reclamation).

The power used by these two and other pumping plants in the CVP and SWP systems is shown in **Table I-1**. Total power used by Jones Pumping Plant during 2006 was about 599 gigawatt hours (GWH), which was about 58 percent of the total power requirements of the CVP system. Banks Pumping Plant's power requirement for 2004 was about 893 GWH, which was about 9 percent of total SWP power use. Jones and Banks Pumping Plant's power needs vary from year to year depending on the climatic conditions and downstream water demands.

The CVP and SWP systems are also significant sources of power generation. Existing levels of power generation at CVP and SWP facilities are shown in **Table I-2**. In 2006 the CVP facilities generated about 7,300 GWH of power. The largest generating facility was at Shasta Lake, which generated about 2,700 G WH of power, or 36 percent of total CVP generation. In 2004, SWP facilities

**Table I-1. Energy Used by Central Valley Project and State Water Project Pumping Plants**

| Facility | Total Power Used – Annual (GWH) |
| --- | --- |
| **Central Valley Project[1]** | |
| Tracy (Jones) Pumping Plant | 599 |
| O'Neill Pumping Plant | 85 |
| San Luis Pumping Plant[2] | 178 |
| Dos Amigos Pumping Plant[2] | 178 |
| **Central Valley Project Total** | **1,039** |
| **State Water Project[3]** | |
| Banks Pumping Plant | 893 |
| **State Water Project Total** | **9,801** |

*Sources: Reclamation, Central Valley Operations Office 2006; California Department of Water Resources 2006*

Notes:

[1]Based on 2006 data.

[2]CVP portion of the joint-use facility.

[3]Based on 2004 data.

Key:
GWH = gigawatt hour(s)

generated about 6,100 GWH, with Hyatt-Thermalito Power Plant generating the highest amount of power at about 2,300 GWH.

The power generated by the CVP system is utilized for pumping and other purposes of the CVP. Any hydroelectric generation not needed by Reclamation for CVP purposes (“surplus power”) is marketed by Western Area Power Administration (Western) to its preference customers at cost-based rates rather than power market rates.

## I.2 Future Conditions with Various Alternative Plans

The DMC Recirculation Project would affect power demand at CVP pumping facilities based on increased pumping loads for recirculation, as well as hydropower production throughout the CVP and SWP systems resulting from system reoperations. The additional amount of hydroelectric power needed by Reclamation to carry out each DMC Recirculation alternative plan is provided below. It is not anticipated that Reclamation would have to purchase additional power for the purpose of the DMC Recirculation Project; rather, it will use more of the power generated by the CVP for CVP purposes.

**Table I-2. 2006 Central Valley Project and State Water Project Hydropower Generation**

| Facility | Annual Power Generation (GWH) |
|---|---|
| **Central Valley Project**[1] | |
| Shasta Power Plant | 2,653 |
| Keswick Power Plant | 533 |
| Trinity Power Plant | 655 |
| Judge Francis Carr Power Plant | 619 |
| Spring Creek Power Plant | 824 |
| Folsom Power Plant | 897 |
| Nimbus Power Plant | 78 |
| New Melones Power Plant | 912 |
| O'Neill Pumping Plant | 88 |
| San Luis Pumping Plant[2] | 131 |
| ***Central Valley Project Total*** | ***7,301*** |
| **State Water Project**[3] | |
| Hyatt-Thermalito Power Plant | 2,294 |
| San Luis Pumping Plant[4] | 183 |
| Alamo Power Plant | 121 |
| Mojave Siphon Power Plant | 80 |
| Devil Canyon Power Plant | 1,282 |
| Reid Gardner Unit | 1,605 |
| Warne Power Plant | 491 |
| ***State Water Project Total*** | ***6,056*** |

*Sources: Reclamation, Central Valley Operations Office 2006; California Department of Water Resources 2006*

Notes:

[1]Based on 2006 data.

[2]CVP portion of the joint-use facility.

[3]Based on 2004 data.

[4]SWP portion of the joint-use facility.

Key:

GWH = gigawatt hour(s)

The additional CVP power used by Reclamation for the DMC Recirculation Project will reduce the amount of CVP surplus power that is made available to Western’s preference customers. The preference customers might make additional purchases from the power market due to the reduced availability of surplus CVP power.

To estimate changes in power demand and generation, output from the CalSim II water operations model was used as input into LTGen. LTGen is a standardized spreadsheet model used to estimate changes in CVP power generation and consumption developed as part of the Common Assumptions Model Package. Results from the output of LTGen were summarized and compared to No-Action Alternative for each alternative plan. The No-Action Alternative conditions were developed based on CalSim II No-Action Alternative conditions, which are described in **Appendix A**.

The discussions and tables below present:

- The estimated additional CVP energy generation used by each alternative plan. These amounts represent the estimated decline in CVP surplus power for each alternative plan that is available for sale to preference customers. For one alternative plan, less energy would be needed for long-term conditions.
- The estimated gross purchase cost of replacement power by the preference customers due to reduction of available CVP surplus power. For purposes of this analysis, the *gross* unit cost of the replacement power by month is estimated from the market-based daily peak bilateral electricity price from the period of 2005 through 2008 reported by the CA ISO for Northern California (California ISO Market Services 2009). PG&E/Western energy prices prior to January 2005 were not fully market-based and are unsuitable for the DMC recirculation study.

The reduced power sales by Western and the matching reduced power purchases by preference customers represent an economic impact to these parties. To establish a worst-case scenario for each alternative plan, the gross unit cost is used to overstate the impacts to Western and the preference customers. The expected impact would actually be the difference between the estimated gross unit cost and the actual unit cost of replacement power purchased by the preference customers.

### I.2.1 No-Action Alternative

Under the No-Action Alternative, the federal government would undertake no actions to improve circulation of the San Joaquin River using the DMC. **Table I-3** shows average energy use for long-term conditions and drought conditions for the Jones Pumping Plant for this alternative plan and compares this use with that of other alternative plans.

### I.2.2 Alternative A1

**Table I-4** shows the additional power that is needed for six alternative plans compared to the No-Action Alternative. Alternative A1 would result in a long-term average annual energy use increase at Jones Pumping Plant of about 2.6 GWH (0.44 percent) compared to the No-Action Alternative. Also compared to

**Table I-3. Jones Pumping Plant Energy Use**

| | No-Action Alternative | Alt. A1 | Alt. A2 | Alt. B1 | Alt. B2 | Alt. C | Alt. D |
|---|---|---|---|---|---|---|---|
| Long-Term Average[1] Energy Use (GWH) | 580.69 | 583.26 | 583.62 | 583.26 | 583.43 | 583.45 | 583.46 |
| Drought Averages[2] Energy Use (GWH) | 386.26 | 390.05 | 391.36 | 390.05 | 391.35 | 391.37 | 391.36 |

Note

[1] Long-term is the average quantity for calendar years 1922–-2002.

[2] Driest period is the average quantity for calendar years 1929–1934, 1976–1977, and 1987–1992.

Key:

GWH = gigawatt hour(s)

the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 3.8 GWH (0.98 percent).

The overall effects on the CVP system would be a net generation decline of about 3.21 GWH (0.09 percent) compared to the No-Action Alternative, resulting in power costs as defined in this analysis of about $203,000 annually. Also compared to the No-Action Alternative, during drought conditions a net generation decline of about 4.86 GWH (0.22 percent) would occur, resulting in power costs of about $303,000 annually.

### I.2.3 Alternative A2

As shown in **Table I-4**, this alternative plan would result in a long-term average annual energy use increase at Jones Pumping Plant of about 2.9 GWH (0.50 percent) compared to the No-Action Alternative. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 5.1 GWH (1.32 percent).

The overall effects on the CVP system would be a net generation decline of about 3.39 GWH (0.10 percent) compared to the No-Action Alternative, resulting in power costs as defined in this analysis of about $213,000 annually. Also compared to the No-Action Alternative, during drought conditions a net generation decline of about 6.82 GWH (0.30 percent) would occur, resulting in power costs of about $417,000 annually.

### I.2.4 Alternative B1

As shown in **Table I-4**, this alternative plan would result in a long-term average annual energy use increase at Jones Pumping Plant of about 2.6 GWH (0.44 percent) compared to the No-Action Alternative. Also compared to the No-

Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 3.8 GWH (0.98 percent).

The overall effects on the CVP system would be a net generation decline of about 4.75 GWH (0.14 percent) compared to the No-Action Alternative, resulting in power costs as defined in this analysis of about $292,000 annually. Also compared to the No-Action Alternative, during drought conditions a net generation decline of about 7.21 GWH (0.32 percent) would occur, resulting in power costs of about $437,000 annually.

### I.2.5 Alternative B2

As shown in **Table I-4**, this alternative plan would result in a long-term average annual energy use increase at Jones Pumping Plant of about 2.7 GWH (0.47 percent) compared to the No-Action Alternative. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 5.1 GWH (1.32 percent). .

The overall effects on the CVP system would be a net generation decline of about 5.24 GWH (0.15 percent) compared to the No-Action Alternative, resulting in power costs as defined in this analysis of about $313,000 annually. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 10.00 GWH (0.45 percent), resulting in power costs of $600,000 annually.

### I.2.6 Alternative C

As shown in **Table I-4**, this alternative plan would result in a long-term average annual energy use increase at Jones Pumping Plant of about 2.8 GWH (0.47 percent) compared to the No-Action Alternative. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 5.1 GWH (1.32 percent) annually.

Other effects would include additional Banks Pumping Plant annual power demands of 1.77 GWH and 2.10 GWH during average and drought conditions, respectively. San Luis Pumping Plant’s power demands would decline 0.86 GWH during long-term average conditions, and would increase by 0.17 GWH during drought conditions. Dos Amigos Pumping Plant’s annual power demands would decline by 1.78 GWH and 2.47 GWH during average and drought conditions, respectively.

Overall effects on the CVP system would be a net generation decline of about 1.04 GWH (0.03 percent) compared to the No-Action Alternative, resulting in power costs as defined in this analysis of about $45,000 annually. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 5.51 GWH (0.25 percent), resulting in power costs of about $306,000 annually.

### I.2.7 Alternative D

As shown in **Table I-4**, this alternative plan would result in a long-term annual average energy use increase at Jones Pumping Plant of about 2.8 GWH (0.48 percent) compared to the No-Action Alternative. Also compared to the No-Action Alternative, during drought conditions, average energy use for this alternative plan would increase by about 5.1 GWH (1.32 percent) annually.

Other effects of Alternative D would include additional Banks Pumping Plant annual power demands of 1.75 GWH and 2.10 GWH during average and drought conditions, respectively. San Luis Pumping Plant's power demands would decline 1.53 GWH and 2.51 GWH during average and drought conditions, respectively. Dos Amigos Pumping Plant's annual power demands would decline by 2.29 GWH and 4.19 GWH during average and drought conditions, respectively.

Overall effects on the CVP system, compared to the No-Action Alternative, would be a net generation increase of 0.61 GWH (0.02 percent) compared to the No-Action Alternative, resulting in power costs of about -$63,000 annually, in other words a cost *savings*. However, during drought conditions, average energy use for this alternative plan would increase by about 1.90 GWH (0.08 percent) as compared to the No-Action Alternative, resulting in power costs of about $70,000 annually.

## I.3 Conclusions

**Table I-3** shows the amount of power used by Jones Pumping Plant for each of the alternative plans. **Table I-4** shows the additional power needed for six alternative plans compared to the No-Action Alternative, as well as the additional economic costs, for this analysis.

DMC Recirculation Alternatives A1, A2, B1, B2, and C would use more power than under No-Action Alternative conditions, and would also result in less surplus power available to Western's preference customers. Alternative D uses less power than the No-Action Alternative for long-term conditions, and more power than the No-Action Alternative under drought conditions.

For the alternative plans where more power is needed, the preference customers might replace the power that is "lost" to them by purchasing additional power in the market, at prices and from sources that cannot be predicted. For purposes of this analysis, the unit cost of the replacement power purchased by the preference customers is estimated by month from the market-based daily peak bilateral electricity price from the period of 2005 through 2008 reported by the CA ISO for Northern California, an average of $70 per megawatt hour (MWH), for the reasons stated above. The worst-case economic costs would be the preference customers total power purchases at market prices, which is represented in this analysis as an average of $70/MWH times the additional MWH estimated for the operation of each alternative plan. The expected impacts are less than those estimated for the reasons given above.

The additional environmental consequences cannot be so easily estimated, except to recognize that CVP hydroelectric power is generally cleaner than the resource mix of readily available market power.

## I.4 References

California ISO Market Services. 2009. *Market Performance Reports for January 2005-December 2008*.

Bureau of Reclamation, Central Valley Operations Office. 2006. *Report of Operations*. Sacramento, CA. December.

California Department of Water Resources. 2006. *Management of the California State Water Project*. Bulletin 132-05. Sacramento, CA. December.

**Table I-4. Expected Additional Energy Needs and Associated Costs for Six Alternative Plans Compared to No-Action Alternative**

| | | Alt. A1 | Alt. A2 | Alt. B1 | Alt. B2 | Alt. C | Alt. D |
|---|---|---|---|---|---|---|---|
| **Power Facilities** | | | | | | | |
| Total Capacity of all Facilities (megawatts) | Long-Term | | 0.44 | 0.01 | 0.59 | 0.88 | 1.61 |
| | Driest Periods | | 1.13 | 0.02 | 1.16 | 1.26 | 3.07 |
| Total Energy Generation of all Facilities (GWH) | Long-Term | | 0.23 | 0.10 | 0.49 | 0.89 | 0.88 |
| | Driest Periods | | (0.36) | 0.18 | (0.11) | 0.96 | (1.48) |
| **Pumping Facilities** | | | | | | | |
| Total Energy Use of all Facilities at load center (GWH) | Long-Term | 3.21 | 3.63 | 4.85 | 5.74 | 1.93 | 0.27 |
| | Driest Periods | 4.86 | 6.47 | 7.39 | 9.89 | 6.47 | 0.42 |
| Jones Pumping Plant Energy Use (GWH) | Long-Term | 2.57 | 2.93 | 2.57 | 2.74 | 2.75 | 2.76 |
| | Driest Periods | 3.79 | 5.10 | 3.79 | 5.09 | 5.10 | 5.09 |
| CVP Banks Pumping Plant Energy Use (GWH) | Long-Term | | | 1.23 | 1.78 | 1.77 | 1.75 |
| | Driest Periods | | | 1.53 | 2.10 | 2.10 | 2.10 |
| CVP San Luis Pumping Plant Energy Use (GWH) | Long-Term | | | | | (0.86) | (1.53) |
| | Driest Periods | | | | | 0.17 | (2.51) |
| CVP Dos Amigos Pumping Plant Energy Use (GWH) | Long-Term | | | | | (1.78) | (2.29) |
| | Driest Periods | | | | | (2.47) | (4.19) |
| **Total** | | | | | | | |
| Net Generation of all Facilities (GWH) | Long-Term | (3.21) | (3.39) | (4.75) | (5.24) | (1.04) | 0.61 |
| | Driest Periods | (4.86) | (6.82) | (7.21) | (10.00) | (5.51) | (1.90) |
| Net Energy Costs ($1,000) | Long-Term | $203.36 | $213.23 | $291.80 | $312.82 | $44.68 | ($62.86) |
| | Driest Periods | $302.62 | $416.86 | $437.46 | $600.39 | $305.79 | $70.36 |

Note:

[1] Long-Term is the average quantity for calendar years 1922–2002.

[2] Driest period is the average quantity for calendar years 1929–1934, 1976–1977, and 1987–1992.

Key:

GWH = gigawatt hour(s)